ATOMIC: Modeling Overview

Juliana Dias and Robert Pincus
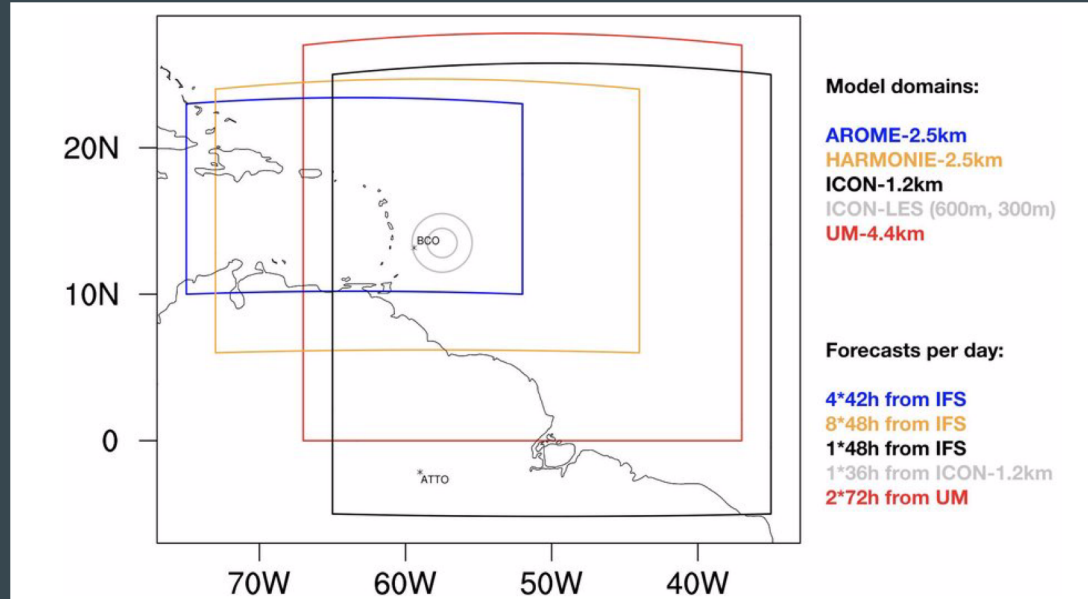
Shallow clouds from Narval1, Foto by B.Stevens

Outline

➜ NWP planned activities during the field campaign
➜ NOAA funded ATOMIC process modeling studies
➜ Diagnostics/Modeling opportunities for PSD

European NWP and global modeling activities

Global forecasts from **ECMWF, ICON** (Germany), **UK Met Office**, and regional forecasts with **AROME, Harmonie, WRF**, and the **UK Met Office** will be freely available during the project, with some data collected on a host at DKRZ.

http://eurec4a.eu/index.php?id=5169

Model domains:

AROME-2.5km
HARMONIE-2.5km
ICON-1.2km
ICON-LES (600m, 300m)
UM-4.4km

Forecasts per day:

4*42h from IFS
8*48h from IFS
1*48h from IFS
1*36h from ICON-1.2km
2*72h from UM

PIs/Contact:
Daniel Klocke - Deutscher Wetterdienst
Vera Schemann - University of Cologne
Pier Siebesma - Delft University of Technology

Global modeling activities: DYAMOND*

Medium-term: The EUREC4A/ATOMIC period will form the next test case for DYAMOND simulations with global storm-resolving models (~4 km resolution, 40 days long, initialized on 20 January 2020)

Participating models: NICAM(coupled), ICON, GEOS, MPAS, IFS (coupled) , SAM and **FV3**.

DYAMOND stands for DYnamics of the Atmospheric general circulation Modeled On Non-hydrostatic Domains. (https://www.esiwace.eu/services/dyamond)
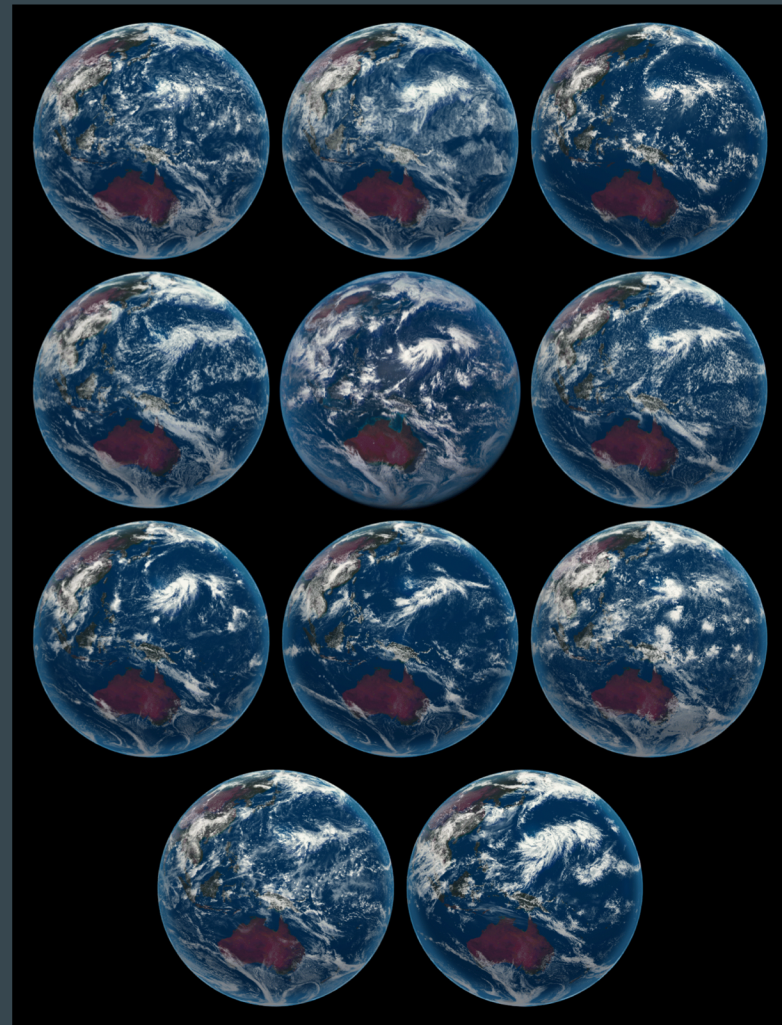
Global modeling activities: opportunities

"EUREC4A aims at advancing understanding of the interplay between clouds, convection and circulation and their role in climate change: ..." (*from EURECA4A overview*)

EUREC4A is aimed at process understanding, not NWP.

PSD could choose to nucleate forecasting activities. Do we want to? What would such activities look like?

Possible NWP topics: role of air-sea coupling (ATOMIC,EUREC4A-OA) in subseasonal forecasts, impacts of evolution of cloud organization, others?

PSD Weather briefings (similar to ENRR)

"Tropical convection is impressive, yeah, but there's a lot of interesting changes in low clouds too, from day to day" (R. Pincus)
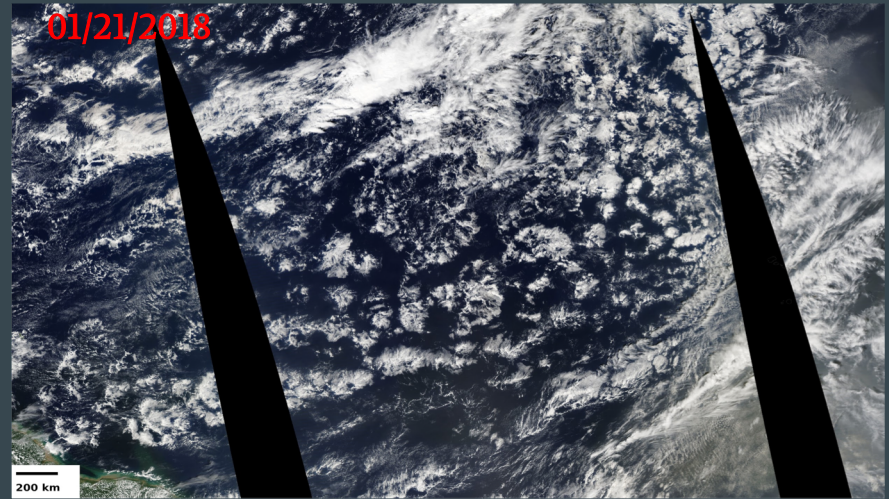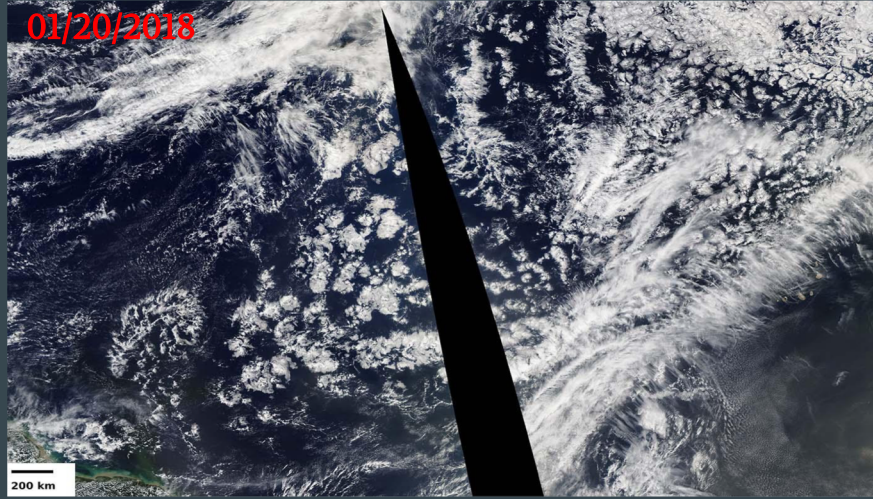

01/20/2018

01/21/2018

200 km
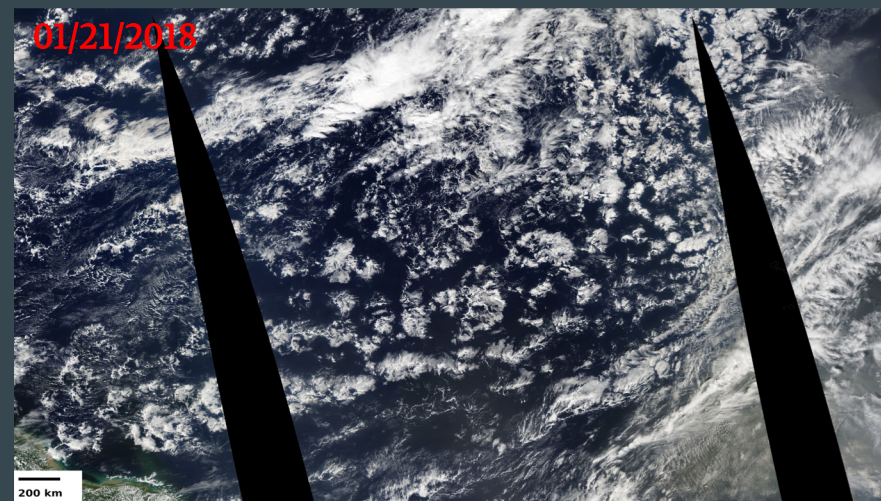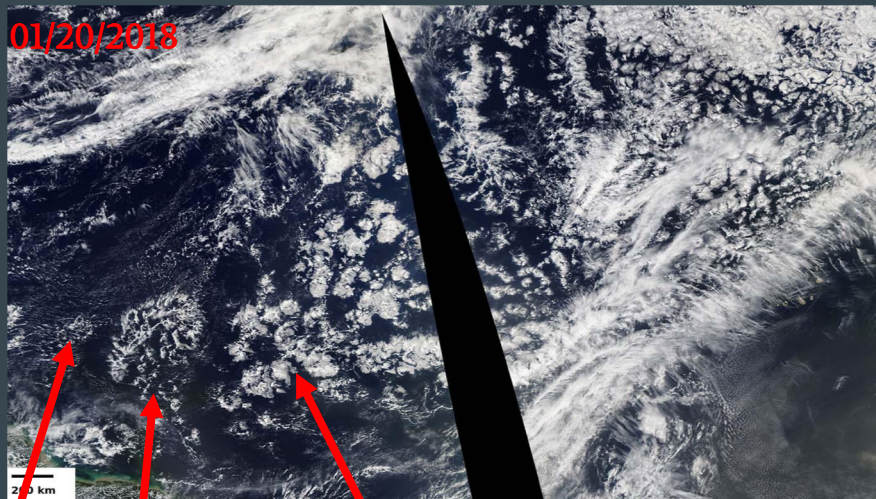
"Sugar"

"Fish"

"Flower"

PSD Weather briefings

01/20/2018
200 km

01/21/2018
200 km

We propose two/three weather briefings per week, looking at things like boundary layer structure, evolution of SST, salinity, SSH, evolution of cloud structure. There will be lots to look at: satellite observations, in situ observations, global and regional forecasts [images from geostationary satellites (GOES 16 - Mesoscale Domain Sectors) will (likely) be available every minute for the project period]

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Process modeling: funded ATOMIC modeling projects

➔ Coupled Ocean-Atmosphere Regional Modeling - Hyodae Seo and Carol Anne Clayson (Woods Hole Oceanographic Institution)
➔ Interaction of the lower atmosphere and upper ocean - McWilliams, Renault, and Sullivan (UCLA and NCAR)
➔ Trade Cumulus Clouds - Kazil, Yamaguchi, and Feingold (NOAA/University of Colorado)
➔ Understanding the role of mesoscale organization in air-sea interactions - Juliana Dias, Robert Pincus and Charlotte DeMott (NOAA/CIRES and CSU)

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Diagnostics/Modeling opportunities for PSD

NWP topics:

➔ role of air-sea coupling (ATOMIC,EUREC4A-OA) in subseasonal forecasts,
➔ NWP impacts of cloud organization and its evolution
➔ ?

The population of clouds over the subtropical oceans is dominated by trade wind cumulus which often organize in a variety of mesoscale shapes and sizes. The subtropical ocean, too, exhibits much fine-scale variability, in the form of sea surface temperature (SST) anomalies and ocean mesoscale eddies. These structures exist in the "grey zone" for current global models,

Shallow clouds from Narval1, Foto by B.Stevens

Fig. from Ringler, 2016 JPO
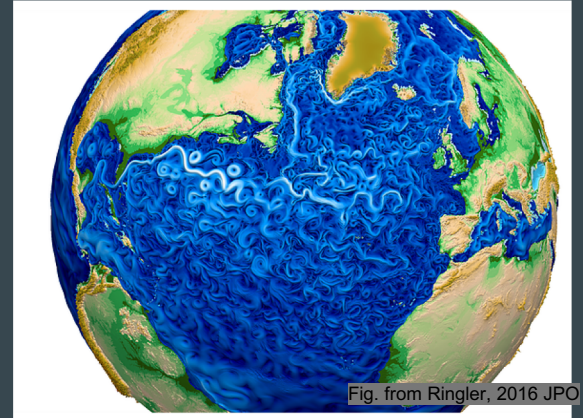
What tools do we need to better understand how small scale processes regulate air-sea coupling and, how do we assess their impacts global forecasts?

ATOMIC related opportunities: Missing tools

➔ Modeling:

Simulations that resolve the motions responsible for shallow clouds require models with spatial resolutions of O(100) m and specialized (simplified) parameterization suites. A well-supported model like this doesn't exist at NOAA (or even the US).

GFDL has developed prototypes based on FV3 - do we want to collaborate with them (and likely GSD) to develop one in the medium-term?

➔ Diagnostics:

What types of air-sea coupling diagnostics are needed to best inform the development of parametrizations (e.g. surface turbulent fluxes/shallow convection)? Could those be data-driven?

There is a lot of expertise at PSD on what goes between subseasonal variability and future climate, so there might be ATOMIC research opportunities in there as well.